

**Joint Legislative Audit and Review Commission  
of the Virginia General Assembly**



**Adequacy and Management of VDOT's  
Highway Maintenance Program**

**JLARC Staff Briefing  
November 13, 2001**

# Introduction

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## Staff for this study:

**Glen S. Tittermary, Division Chief**

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**Jason W. Powell**

**Scott F. Demharter**

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# Presentation Outline

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- ☒ **Introduction and Summary of Findings**
- ☐ **Background**
- ☐ **Current Condition of Virginia's Highway Assets**
- ☐ **Funding Virginia's Highway Maintenance Program**
- ☐ **Management of the Maintenance Program**

# Study Mandate

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- In November 2000, the Joint Legislative Audit and Review Commission directed staff to conduct a study of Virginia's highway maintenance program and to address whether:
  - Maintenance is treated as the first funding priority as required by the *Code of Virginia*;
  - VDOT's organizational and management structure support the highway maintenance program;
  - Staffing, equipment, materials, and other resources are adequate to properly maintain all highway assets;
  - VDOT has the appropriate processes to measure and evaluate the quality of its maintenance work on State highways; and
  - VDOT uses the appropriate mix of State forces and private contractors for highway maintenance and whether an asset management approach could be expanded beyond the interstate system to the other road systems

# Study Issues

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- **What is the current condition of Virginia's highway and road pavements, bridges, and other highway assets?**
- **Is the maintenance program adequately funded to meet the maintenance needs of the State's highway system?**
- **What is the current status of VDOT's oversight of the street and road maintenance activities performed by the cities, towns, and the counties of Arlington and Henrico?**

# Study Issues

(continued)

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- How have the department's attempts to implement an asset management approach affected the department's ability to provide highway maintenance?
- Is the maintenance program effectively managed, organized, and staffed in order to provide adequate highway maintenance?

# Research Activities

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## ■ Structured interviews with:

- **Secretary of Transportation, Deputy Commissioner for Project Management, State Maintenance Engineer, State Traffic Engineer, State Equipment Engineer, State Structure and Bridge Engineer, Administrator of the Intelligent Transportation Systems section, Director of Financial Planning and Debt Management**
- **The Maintenance Division's Contract Manager, the Maintenance Division's Directors of: Finance, Pavement Management Program, Integrated Maintenance Management Program, and the Inventory and Condition Assessment System**
- **All nine district maintenance engineers, three district maintenance assistants, one district traffic engineer, two district equipment and facilities managers, a tunnel maintenance engineer, and a tunnel maintenance administrator**

# **Research Activities**

## **(continued)**

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### **Structured interviews (continued):**

- **Staff at the residency and area levels, including:  
four resident engineers, twelve residency  
transportation operations managers, and four area  
headquarters superintendents**
- **Representatives from local road maintenance  
programs and private contractors**
- **Review of selected other state highway maintenance  
programs**
- **Attendance of all monthly meetings of the Maintenance  
Program Leadership Group from February 2001 through  
August 2001**

# **Research Activities**

## **(continued)**

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### **■ Data collection and analysis:**

- Survey of all 50 residency transportation operations managers**
- Survey of all 79 cities and towns receiving State payments for maintenance operations**
- Site visits to all districts as well as selected residencies and area headquarters**
- Analysis of VDOT's statewide sample of 11,161 directional miles of interstate and primary pavement conditions and the general rating conditions for 11,768 bridges maintained by VDOT**

# Summary of Staff Findings

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- **Eighty percent of Virginia's interstate and primary pavements appear to be "fair" or better condition based on VDOT pavement condition ratings**
- **Forty percent of the bridges for which VDOT has maintenance responsibility appear to in need of repair or rehabilitation based on general condition ratings supplied by VDOT**
- **Although the secondary system accounts for approximately 70 percent of the State maintained road mileage, VDOT does not formally measure pavement conditions on secondary roads**

# Summary of Staff Findings

## (continued)

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- **Repairing pavements identified as “poor” or “very poor” would likely cost more than \$105.6 million**
- **Repairing or rehabilitating bridges identified as needing some type of maintenance work would likely cost more than \$1.5 billion**
- **The highway maintenance program appears inadequately funded to provide “reasonable and necessary” maintenance of the State’s highway system as required by law**

# Summary of Staff Findings

## (continued)

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- **Current six year projected allocations for the highway maintenance program indicate level funding in FY 2004 through FY 2007, although expenditures have increased by more than four percent annually since 1996**
- **VDOT should provide greater oversight of the maintenance activities provided by the cities, towns, and counties currently receiving State payments for maintenance of the streets and roads in those jurisdictions**
- **Although it has spent \$39 million on automated systems to support asset management, VDOT has yet to implement asset management for its maintenance program**

# Presentation Outline

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- ☐ Introduction and Summary of Findings
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- ☐ Current Condition of Virginia's Highway Assets
- ☐ Funding Virginia's Highway Maintenance Program
- ☐ Management of the Maintenance Program

# Statutory Requirements for Highway Maintenance

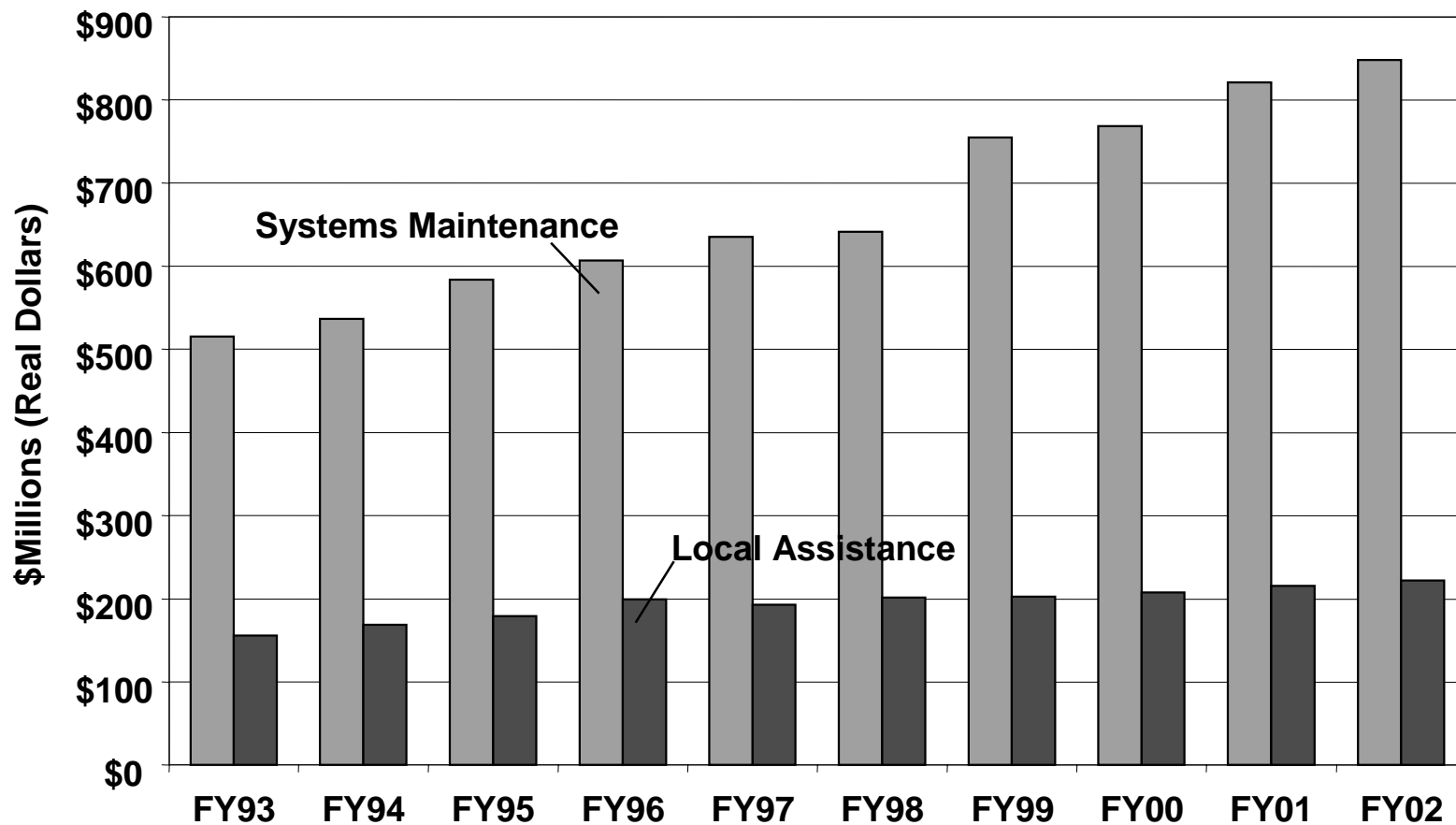
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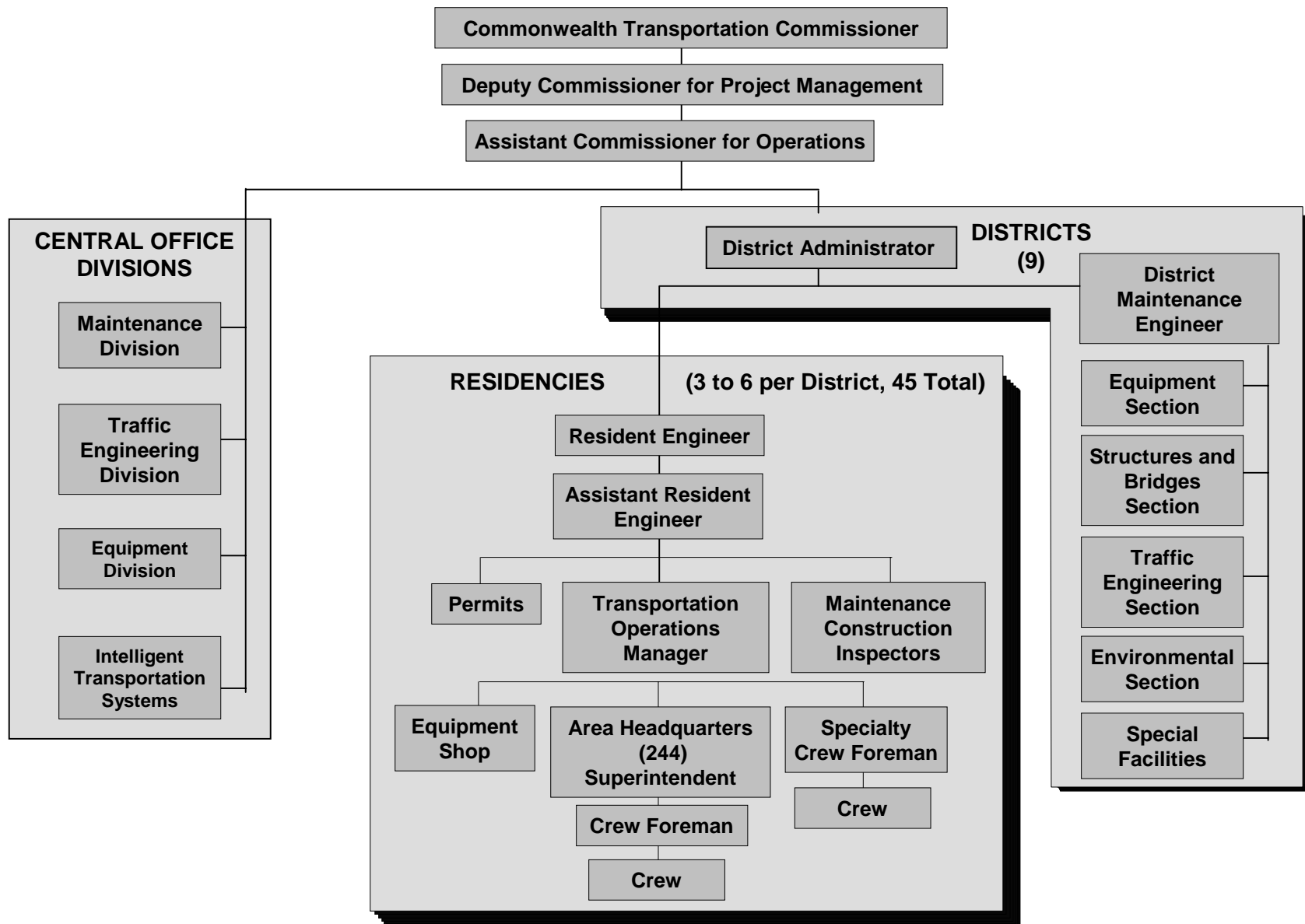
- The *Code of Virginia* defines actual maintenance activities as ordinary, replacement, and any other category designated by the Commissioner
- The *Code of Virginia* requires the Commonwealth Transportation Board (CTB) to dedicate an amount deemed “reasonable and necessary” for the maintenance of roads on the interstate, primary, secondary, and urban systems prior to all other funding allocations
- The *Code of Virginia* also establishes criteria for payments for maintenance purposes to the cities, certain towns, and the counties of Arlington and Henrico

# Appropriations for Highway Systems Maintenance and Financial Assistance to Localities FY 1993 – FY 2002

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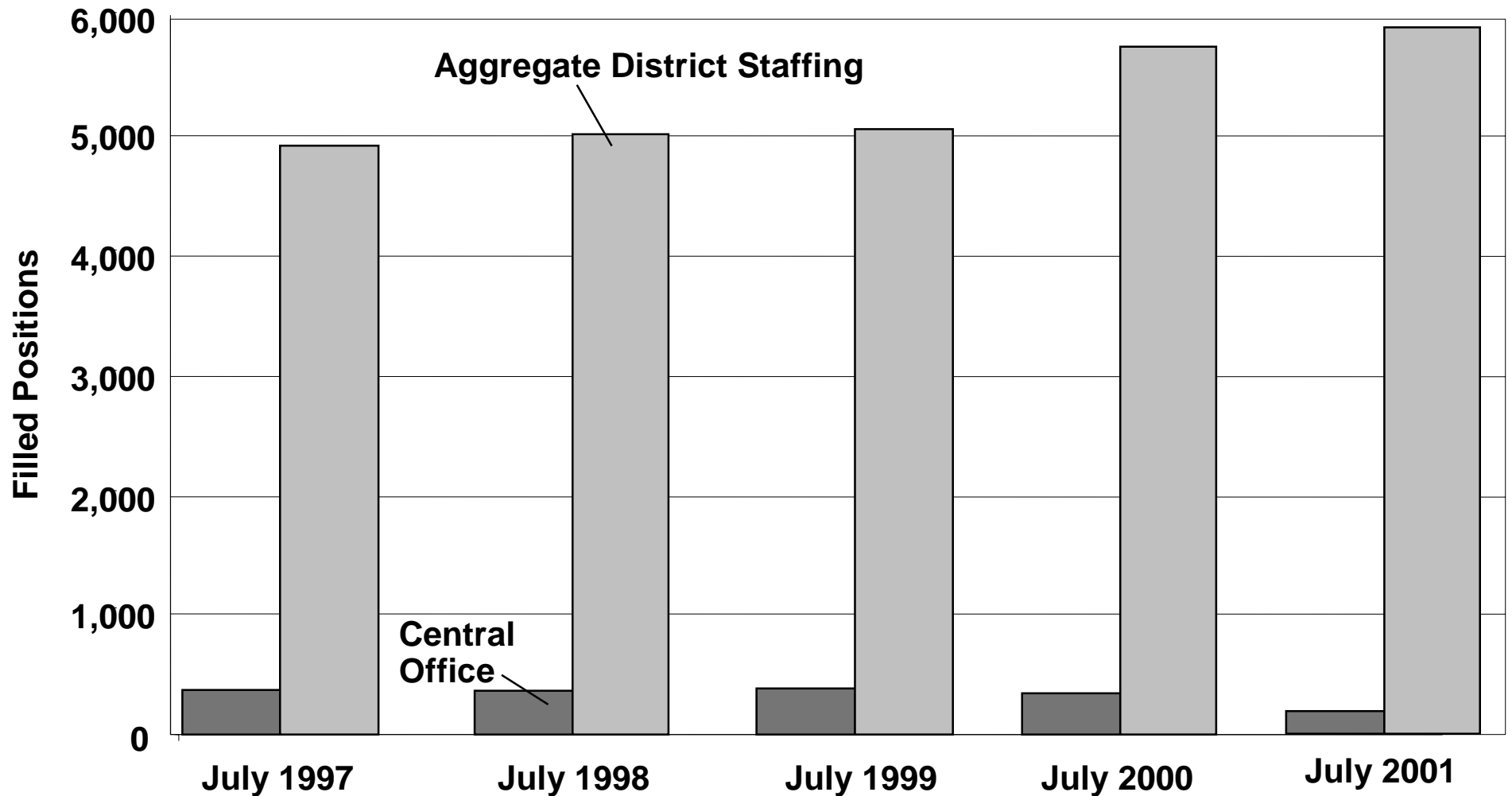


# Organizational Structure of VDOT's Maintenance Program



# Staffing Levels for the VDOT Maintenance and Operations Program

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# Presentation Outline

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- ☐ Management of the Maintenance Program

# **VDOT Developed Its Own Interstate and Primary Pavement Distress Indices**

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- **VDOT has developed a pavement condition rating system through the Pavement Management Program**
  - **Designed to provide detail about the quality of the pavements to help VDOT choose the correct repair technique**
  - **VDOT has developed a load distress rating and a non-load distress rating to measure surface and subsurface deficiencies, respectively**
  - **VDOT uses the lower value of these two ratings as the critical condition index to assess the general pavement condition. A pavement with a critical condition index less than 60 is considered in poor condition by VDOT and a condition rating less than 50 is considered very poor**

# Examples of Deficient Pavement Conditions

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Transverse  
pavement  
cracking  
due to non-  
load-related  
distresses

Longitudinal  
pavement  
cracking  
due to load  
related  
distresses



# Examples of Deficient Pavement Conditions

(continued)

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Alligator  
cracking  
due to load-  
related  
distresses



# Examples of Deficient Pavement Conditions (continued)

22

De-lamination  
of pavement  
surface



# Current Conditions of Interstate and Primary Pavements Appear Good

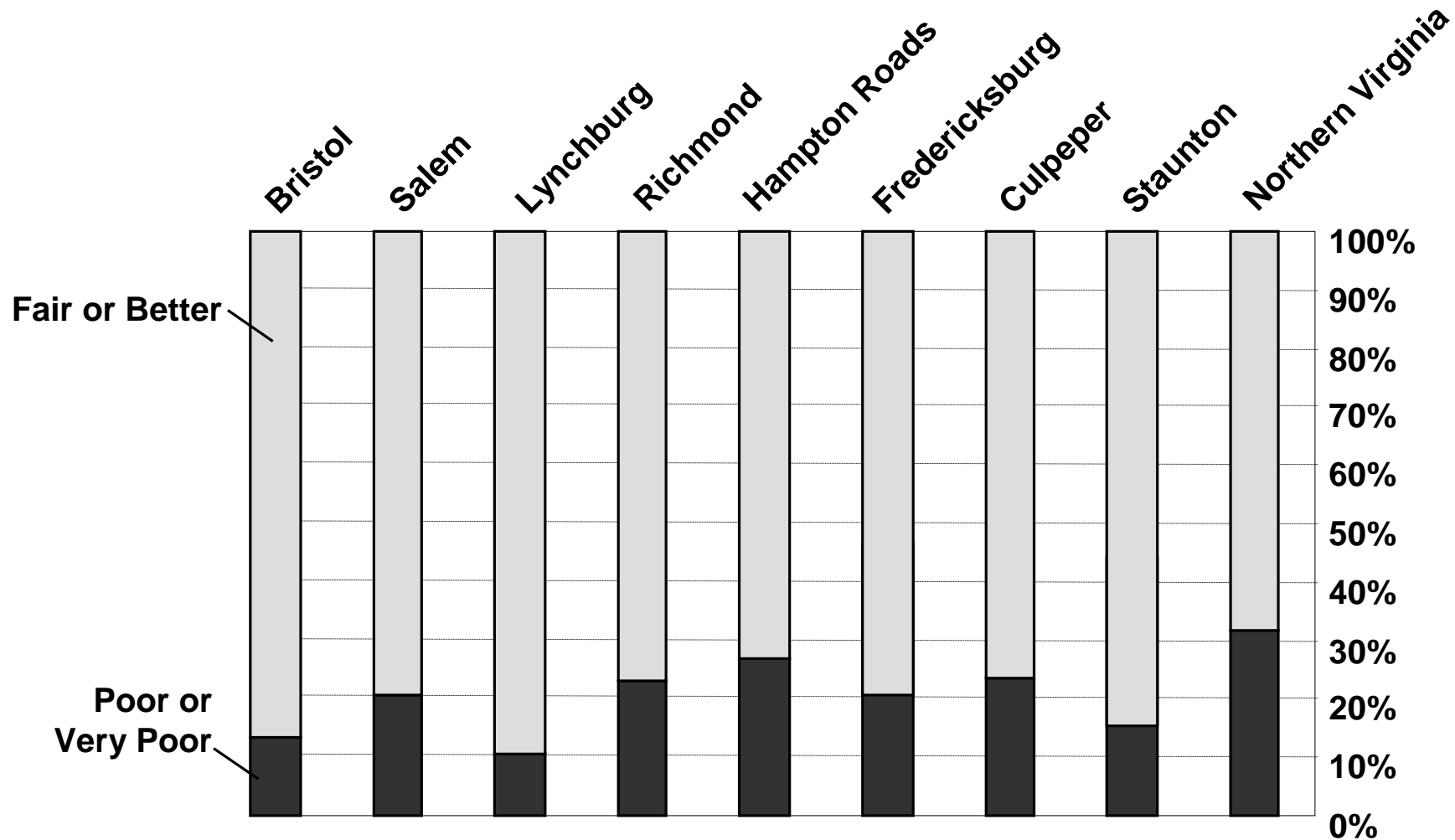
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<b><u>System</u></b>	<b><u>Total Sample Miles</u></b>	<b><u>Total Deficient Miles</u></b>	<b><u>Percent Deficient Miles</u></b>
Interstate	1,834	364	20%
Primary	9,328	1,842	20%
Total	11,161	2,207	20%

# Interstate and Primary Pavement Conditions by District

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# **Pavement Management Program Should Be Better Utilized**

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- **The automated Pavement Management Program does not include pavement condition ratings for secondary roads although these roads comprise more than 70 percent of the State's system**
- **VDOT has changed the condition indices used to rate the pavement conditions several times in recent years making it impossible to compare conditions from year to year**
- **It would likely take at least another two years before a data set could be fully operational with ratings for all road systems**

# **VDOT Is Required to Report Bridge Condition Data to FHWA**

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- **States are required to inspect the conditions of each bridge on the National Bridge Inventory (NBI) at least once every two years and report those conditions to FHWA**
  - **VDOT inspects and reports conditions on about 10,000 bridges and 2,500 culverts at least once every two years to FHWA**
  - **VDOT also inspects 2,500 bridges and 4,500 culverts that are not part of the NBI**
- **FHWA safety inspections require visual inspections and ratings of the condition of the bridge deck, superstructure, and substructure. Girders, sign structures, underwater conditions related to bridge piers are also required to be inspected**

# **VDOT Uses Measurements Established by FHWA for Rating Bridge Conditions**

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- **According to FHWA, general condition ratings are used to evaluate the current condition of a structure against the initial condition at the time of construction**
  
- **An evaluation is required of the physical condition of the materials for the:**
  - **Deck – cracking, scaling, broken welds, or splitting depending on if the deck is concrete, steel, or timber**
  - **Superstructure – cracking, deterioration, section loss and misalignment of bearings**
  - **Substructure – cracking, scour, collision damage, settlement, misalignment, and corrosion**

# Example of Bridge Deck in Need of Repair

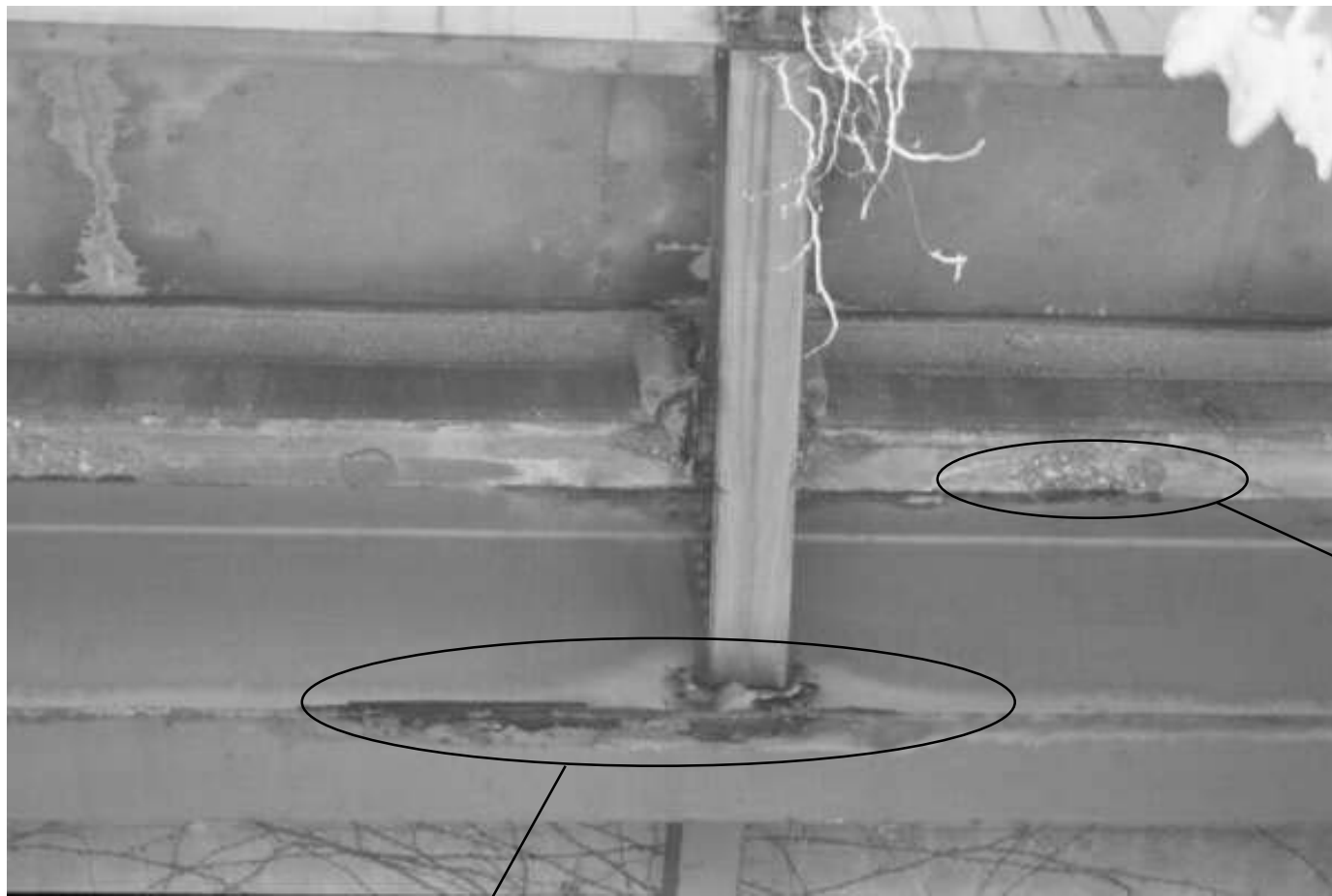
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Extensive  
patching of  
bridge deck



# Example of Bridge Superstructure in Need of Repair

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Extensive rusting

Deterioration

# Example of Bridge Substructure in Need of Repair

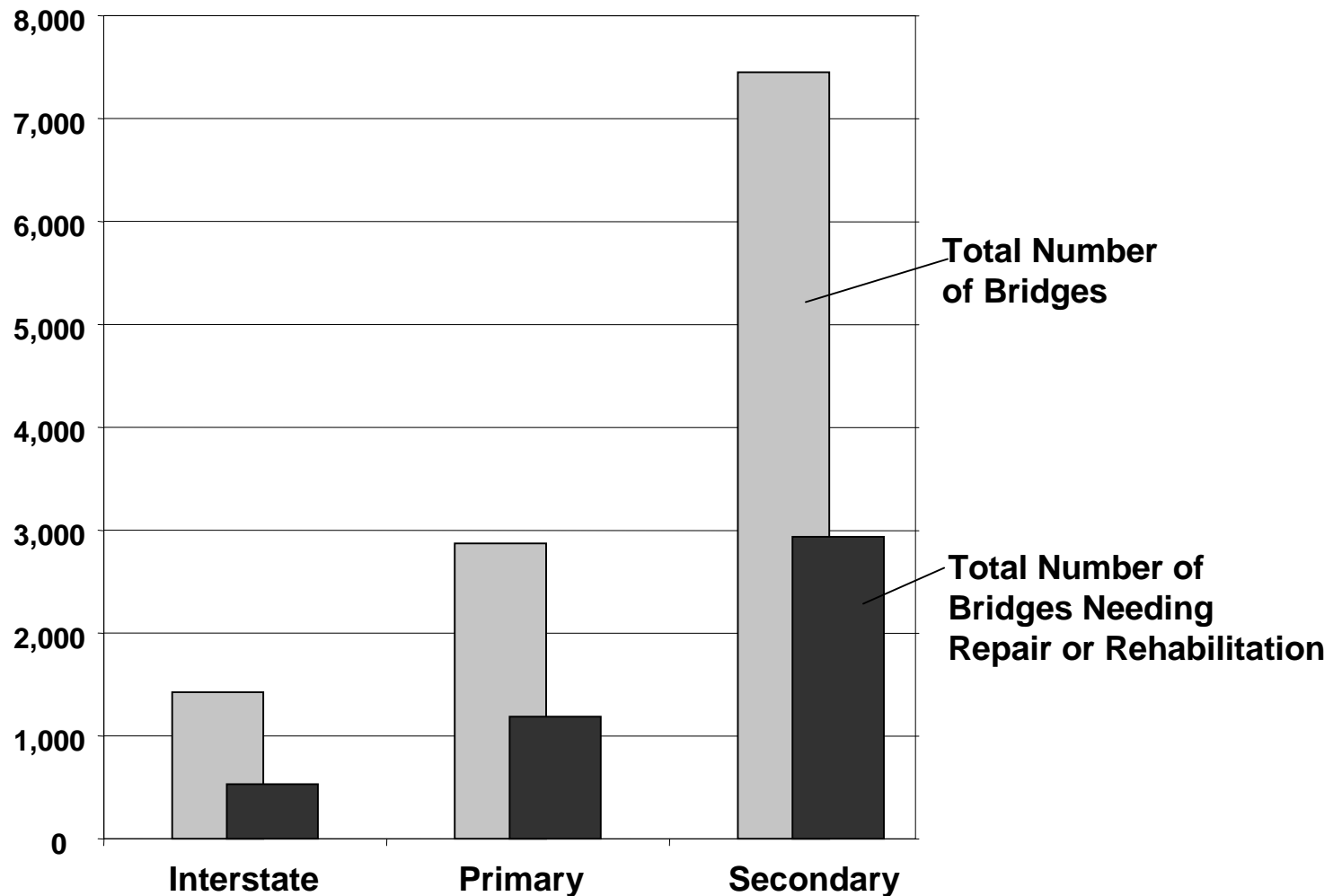
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Damage on  
bridge pier

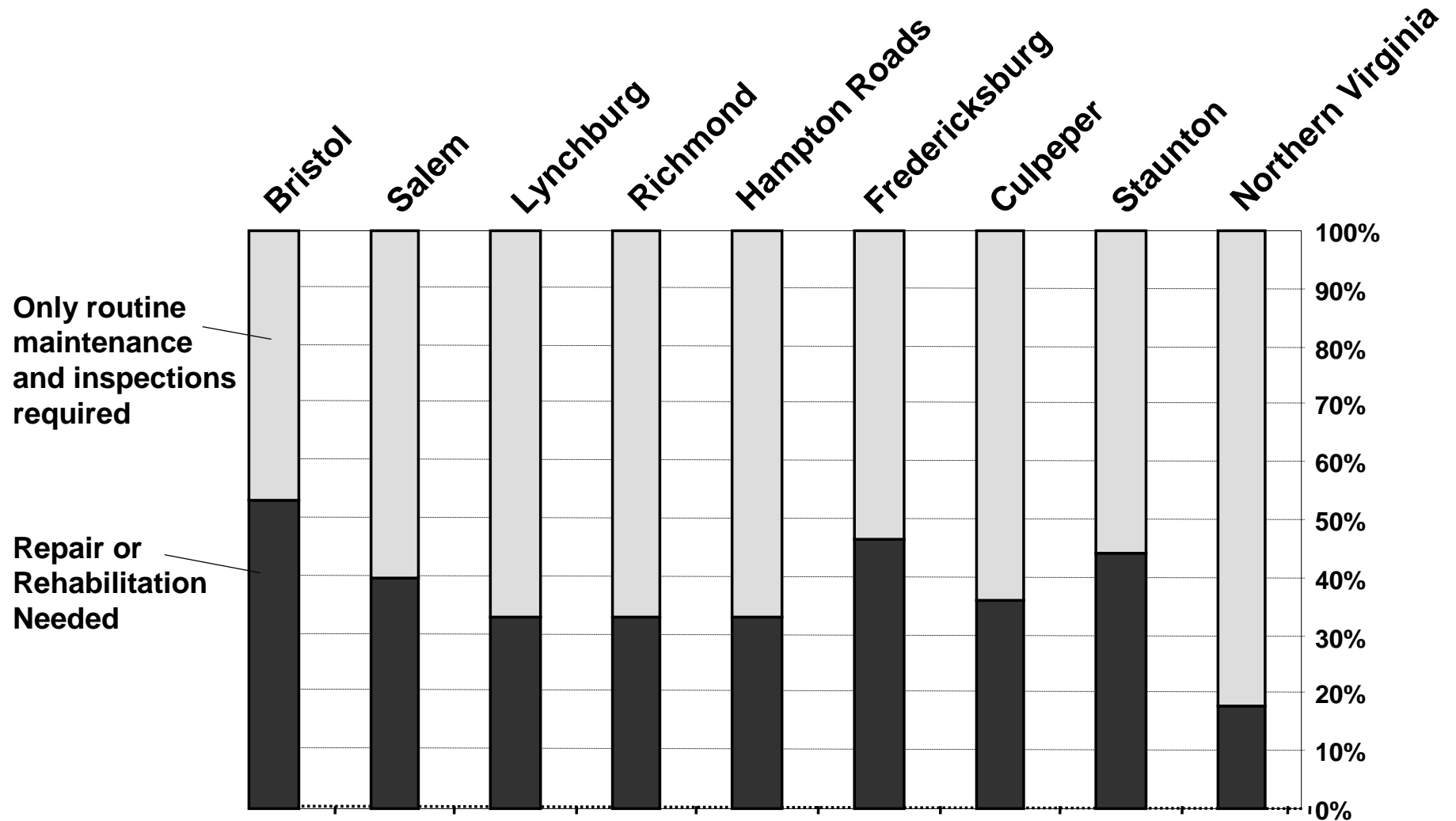
# Forty Percent of the Bridges Maintained by VDOT Need Maintenance Work

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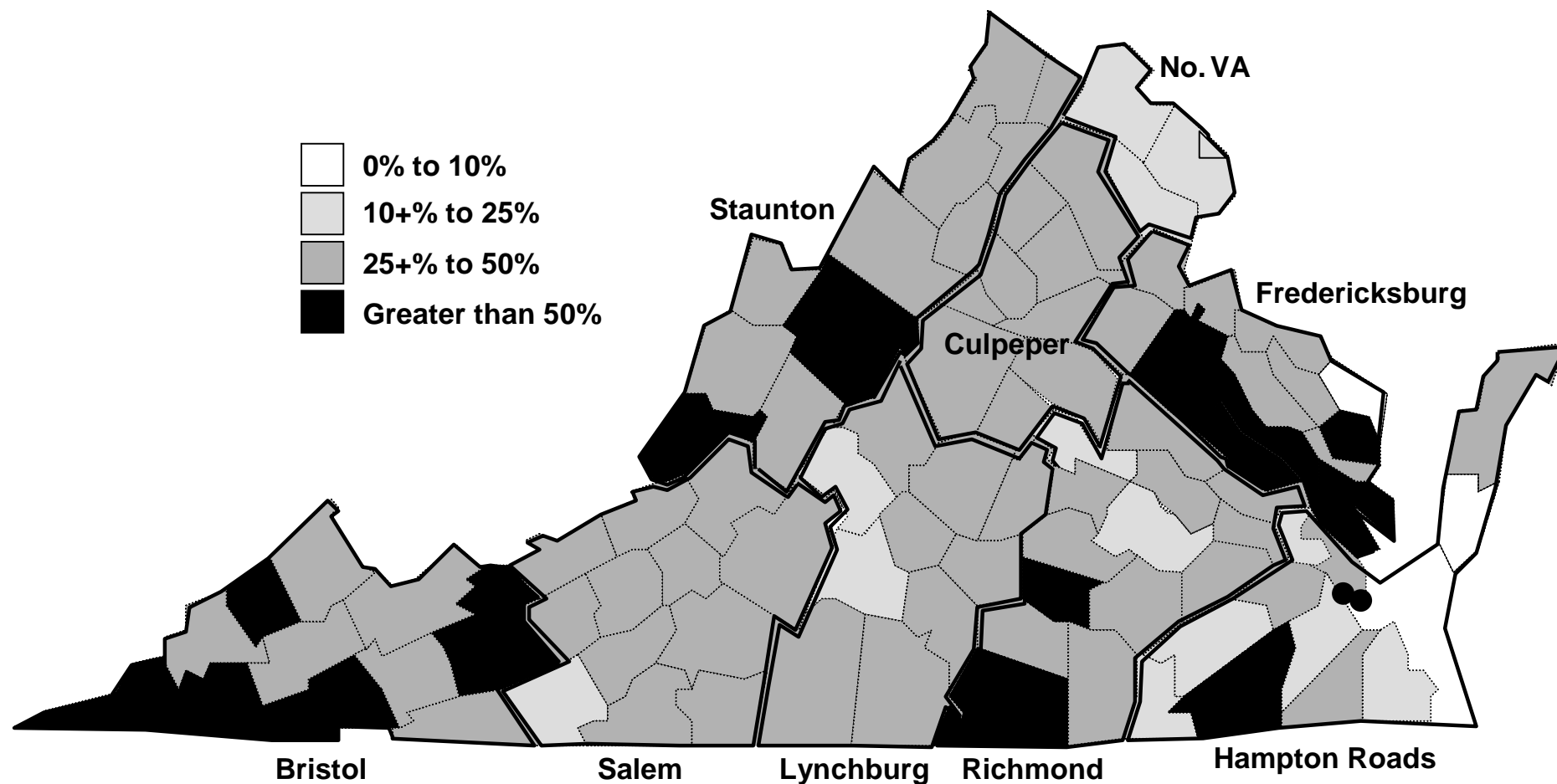
# Percentage of VDOT Maintained Bridges Which Need Maintenance Work, by District

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# Bridges Maintained by VDOT in Need of Maintenance Activities, by County

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Note: Does not include locality-maintained bridges for which VDOT has no maintenance responsibility.

# Age of Bridges Is Useful for Identifying Maintenance Needs

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- According to the State structure and bridge engineer, FHWA has recently recommended bridges be built to a 75-year functional life-cycle

## VDOT Maintained Bridges by Age, 2001:

	Year Bridge Built				
	<u>Before 1926</u>	<u>1926–1940</u>	<u>1941–1960</u>	<u>1961–1980</u>	<u>1981- present</u>
Total Bridges	342	3,449	1,760	4,180	2,037
Bridges Needing Repair	235	1,658	920	1,716	129
Percent in Need of Repair	69%	48%	52%	41%	6%

# **VDOT Does Not Formally Evaluate the Condition of Non-Pavement, Non-Bridge Assets**

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- **VDOT is responsible for the maintenance of several other types of highway and non-road assets in addition to the State's pavements and bridges, including:**
  - **Vegetation, including grass mowing and tree trimming;**
  - **Pipes and ditches;**
  - **Traffic signals and signs; and**
  - **Guardrail**
- **VDOT does not perform a systematic review of these highway assets on a regular basis. Repairs are made after an asset has failed rather than maintaining the asset using a preventive strategy**

# Other States Perform Formal Assessments of Roadway Conditions

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- North Carolina department of transportation is statutorily required to survey and report on the condition of the state highway system on a biennial basis and use this report to develop its annual maintenance program
- Florida and Texas also require their departments of transportation to conduct systematic reviews of at least a portion of the highway assets in their systems
- VDOT does not perform similar statewide assessments of asset quality, although one of VDOT's automated systems is supposed to provide that function

# Recommendation

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- **The Virginia Department of Transportation should assess the need for additional maintenance activities beyond those currently identified on non-pavement assets pending full implementation of its asset management program. The Maintenance Program Leadership Group could make such an assessment based on requests for non-pavement maintenance from the residencies.**

# Presentation Outline

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# **VDOT Repairs Pavement Surfaces by Applying Overlays**

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- **VDOT uses overlays to rehabilitate pavements that are rated as deficient**
- **According to VDOT, the average costs for asphalt overlays for pavements on interstates was \$80,441 per directional mile and for primaries it was \$41,437 per directional mile based on the 2001 pavement overlay schedule**

# Cost to Repair Interstate and Primary Pavements May Be \$105.6 Million

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<u>Road System</u>	<u>Average Asphalt Cost Per Directional Mile</u>	<u>Total Deficient Miles</u>	<u>Estimated Total Cost</u>
Interstate	\$ 80,441	364	\$ 29,280,524
Primary	\$ 41,437	1,842	\$ 76,326,954
Total		2,207	\$105,607,478

# **Costs to Repair or Rehabilitate Bridges Maintained by VDOT**

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- **According to VDOT structure and bridge staff, unit costs for repair of:**
  - **Decks are estimated to be \$45 per square foot**
  - **Superstructures are estimated to be \$60 per square foot**
  - **Substructure units are estimated to be \$10,000 per unit**
  
- **To determine the estimated cost to repair the bridges maintained by VDOT, JLARC staff applied the estimated unit costs to the bridge components identified as needing some level of maintenance work**

# Costs to Repair or Rehabilitate Bridges May Be \$1.5 Billion

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Condition	Deck		Superstructure		Substructure		Total Estimated Cost
	Number	Total Sq. Ft. (1000SF)	Number	Total Sq. Ft. (1000SF)	Number	Total Number Units	
Generally Fair	2,041	11,239.2	2,083	11,002.8	2,287	8,263	\$1,248,562,000
Poor	430	2,000.9	708	2,204.9	410	1,433	\$ 236,664,500
Serious / Critical	14	139.9	47	427.4	10	108	\$ 33,019,500
<b>Totals</b>	\$ 602,100,000		\$ 818,106,000		\$ 98,040,000		\$1,518,246,000

■ Costs, according to VDOT structure and bridge staff:

Deck repair: \$45 per square foot

Superstructure repair: \$60 per square foot

Substructure repair: \$10,000 per unit

# ***Code of Virginia* Requires Funding Priority Be Given to Maintenance**

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## **■ Section 33.1-23.1.A of the *Code of Virginia* states:**

**The Commonwealth Transportation Board shall allocate each year from all funds made available for highway purposes such amount as it deems reasonable and necessary for the maintenance of roads within the interstate system of highways, the primary system of highways, the secondary system of state highways and for city and town street maintenance payments made pursuant to section 33.1-41.1 and payments made to counties which have withdrawn or elect to withdraw from the secondary system of state highways pursuant to section 33.1-23.5:1**

# **VDOT Projects Level Funding for Highway Systems Maintenance Beginning in FY 2004**

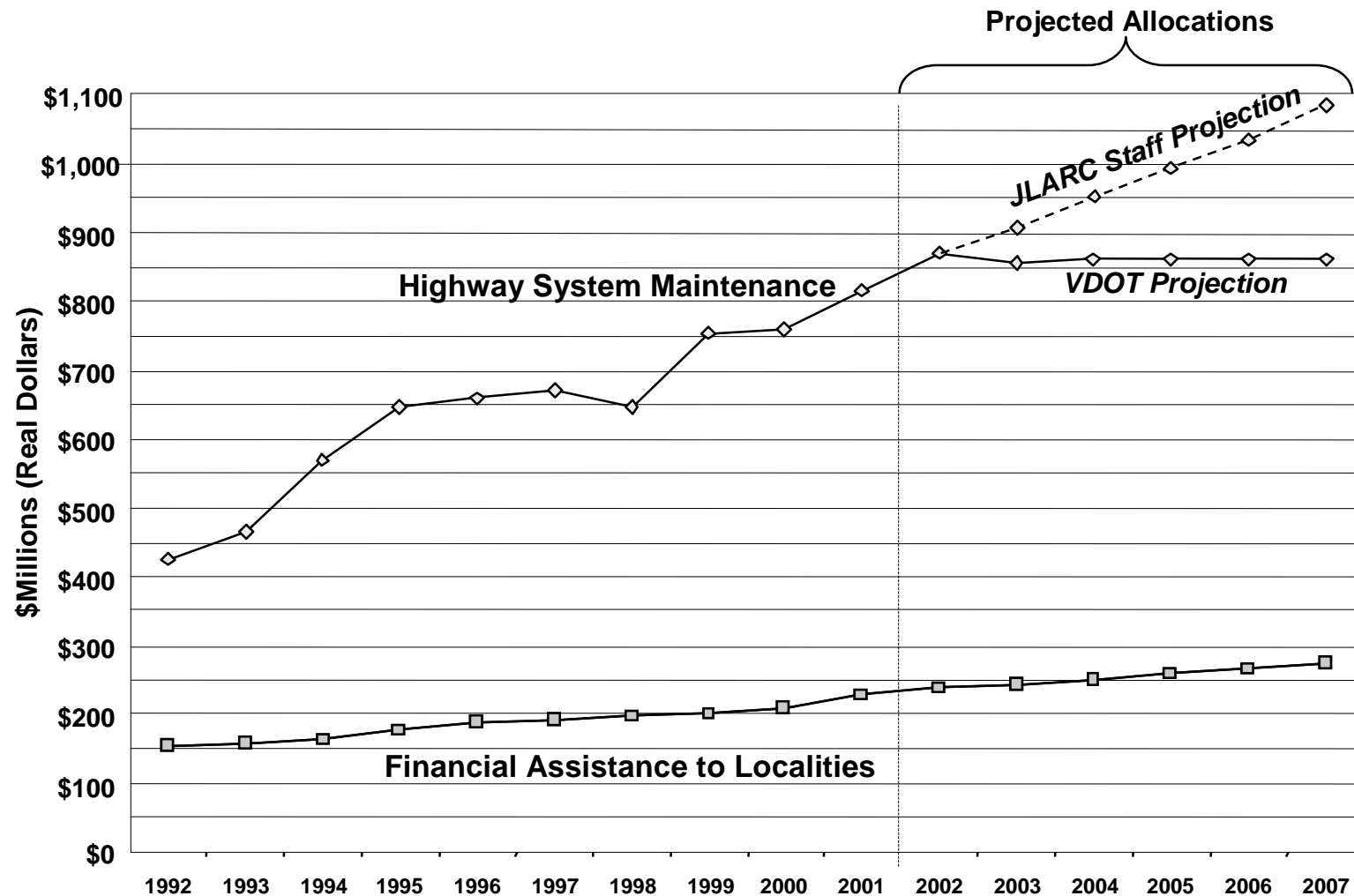
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- **VDOT has projected level funding for the highway maintenance program beginning in FY 2004 through FY 2007 although expenditures have grown at greater than four percent annually since FY 1996**
- **Level funding appears to distort the amount of funding available for use in construction because the funding for construction is determined based on the amount remaining after funding for maintenance has been allocated**

# Expenditures and Projected Allocations for Highway System Maintenance and Financial Assistance to Localities FY 1992 – FY 2007

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# Funding for Localities Maintaining Own Streets May Be Inadequate

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- Since 1997, Virginia has provided a total of approximately \$1 billion to the cities and certain towns, and the counties of Arlington and Henrico for the purposes of maintaining streets and roads
- According to VDOT urban division documents, localities may have spent greater than \$200 million more than was received in State payments for maintenance, construction, and reconstruction
- Seventy-six percent of respondents to the survey suggested that total local expenditures on maintenance were insufficient to meet the identified local needs

# No Systematic Assessment of Conditions in Localities Is Performed

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- There are more than 10,000 miles of streets in the urban system and another 1,500 miles of secondary roads in Arlington and Henrico counties for which VDOT has no direct maintenance responsibility
- Section 33.1-41.1 of the *Code of Virginia* requires VDOT to annually inspect the principal and minor arterials within each city and town receiving State payments which comprise only 25 percent of the lane mileage in the urban system
- Section 33.1-23.5:1 of the *Code of Virginia* does not require VDOT to perform any assessment of the conditions of the secondary roads maintained in the counties of Arlington and Henrico

# Recommendations

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- **Recommendations to improve the effectiveness of the financial assistance to localities program include:**
  - **The General Assembly may wish to amend the *Code of Virginia* to require greater oversight of the conditions of the streets and roads in those localities receiving State payments**
  - **VDOT should study the estimated costs of developing and implementing a method to evaluate the conditions of the pavements and other assets in these localities and determine the costs to address deficiencies**
  - **VDOT should develop a uniform reporting instrument for the localities receiving State payments and should include total allocations and expenditures for maintenance, construction, and reconstruction detailed separately**

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# **Asset Management Is a Proactive Approach to Highway Maintenance**

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- **An outcome-based approach to maintenance**
  - **Monitors the condition of highway assets**
  - **Optimizes the preservation, upgrading, and timely replacement of highway assets through cost effective performance management and cost allocation**
- **VDOT conducted statewide highway asset inventory in the early 1980s**
- **Provision of highway maintenance activities will remain the same**
- **VDOT projects full implementation of asset management to occur by 2006**

# **VDOT Has Developed and Implemented Some Asset Management Principles**

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- In 1995, VDOT was the first state department of transportation to contract for a long-term, performance-based asset management approach for total highway maintenance. This contract was renewed this summer
- VDOT created an internal management group to provide leadership for the maintenance program to address funding, scheduling, and resource allocation issues
- To date, VDOT has spent \$39 million on systems to support asset management, but asset management has not been implemented due to numerous delays in the development of certain automated systems

# **VDOT Is Developing Several Automated Systems to Implement Asset Management**

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## **■ Integrated Maintenance Management Program:**

- Pavement Management Program**
- Bridge Management System**
- Virginia Operational Information Systems**
- Inventory and Condition Assessment System (ICAS)**
- Integrated Maintenance Management System (IMMS)**

# Attempts to Implement ICAS Have Met Delays and Problems

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- Projected costs for the ICAS project are \$53.6 million
- Data collection for ICAS was piloted in the counties of Augusta, Fairfax, and Fauquier and required a complete asset inventory and condition assessment on the interstate, primary, and secondary roads
- During July 2001, VDOT delayed the statewide rollout of ICAS after the contractor failed to deliver the required data for Fairfax county on time
- A VDOT internal audit of the ICAS project identified potential problems with how estimated costs were represented and whether VDOT management were adequately informed of changes in the overall costs of the project

# Attempts to Implement IMMS Have Met Delays and Problems

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## ■ VDOT began development of IMMS in 1996

- In 1998, development of IMMS was delayed for a year and a half as a result of VDOT cash flow problems and implementation of a new financial management system
- In 2001, development of IMMS was again delayed as a result of an agency-wide initiative, known as Synergy, to develop a single automated system to handle all of the department's needs
- It is unclear what priority IMMS or the business requirements needed to implement IMMS will have as part of the new system

# Recommendations

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- **Recommendations for VDOT's future decisions related to IMMP and asset management include:**
  - **Implementing ICAS as soon as possible by focusing on the interstate and primary systems and including information on the secondary system as that work is done**
  - **Providing a detailed timetable of expected Synergy milestones and projected costs to the House Appropriations, Senate Finance, and House and Senate Transportation committees**
  - **Reaffirming the commitment and priority of promptly and fully institutionalizing asset management through the implementation of the business requirements and automated systems necessary as soon as possible**

# Maintenance Program Does Not Systematically Measure Productivity

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- **Measurements of productivity existed until 1995**
  - VDOT had an automated system in place to track the use of materials and labor based on expenditures that assisted maintenance managers in planning work and programming funding
  - Maintenance managers questioned validity of data provided to the system and usefulness of productivity measures
- **Since 1995, VDOT has not been able to systematically measure the productivity of its maintenance activities**
- **VDOT is developing new measures based on achieved outcomes related to desired levels of service as part of its asset management approach**

# **Inconsistency of Carry-Forward Funding Affects Ability to Program Maintenance Activities**

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- **According to VDOT maintenance managers, the end of the fiscal year falls during the middle of the prime maintenance activity season of April through October making management of funds and activity planning difficult**
- **The process for identifying, scheduling, funding, and completing repair activities on road surfaces can take as much as 20 months**
- **VDOT has approved 45 percent of the funds requested by the maintenance program for carry-forward since FY 1997; in FY 2001 the maintenance program did not request carry-forward funding**

# **Inconsistency of Carry-Forward Funding Affects Ability to Program Maintenance Activities**

**(continued)**

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- **Six of the nine district maintenance engineers expressed serious concern about the affect not being able to carry unused funds forward has on the ability to schedule and 72 percent of the transportation operations managers responding to the JLARC staff survey indicated it had impacted their residency or area headquarters since FY 1997**
  
- **Several alternatives to the current method have been suggested as possible solutions:**
  - **Allowing for funds to be programmed to specific projects regardless of the number of years that might be required to finish that project;**
  - **Allowing funds to be programmed over the biennium instead of within a single fiscal year; and**
  - **Allowing funds to be programmed over a six-year period similar to the construction program**

# **Availability of State Forces and Contractors Affects VDOT's Ability to Address Highway Maintenance Needs**

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- **An internal VDOT maintenance management group identified a need for an additional 1,800 positions in 2000 as part of VDOT's workload planning study**
- **VDOT has not awarded any long-term performance based maintenance contracts other than the original VMS contract in 1995 and the renewal in 2001**
- **VDOT contracting levels for maintenance activities have remained at approximately 45 percent of maintenance expenditures since 1992 and there has been a slight increase in filled positions in the field**

# **VDOT Has Refocused Some Maintenance Positions to Non-interstate Assets**

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- **VDOT's 2000 – 2002 biennium budget request stated that contracting has “allowed State maintenance forces to concentrate primarily on emergency, safety, and priority maintenance tasks”**
- **Of the 25 VDOT operations managers who indicated that increasing the use of private contractors would help their residency and area headquarters perform their primary functions:**
  - **Fifteen indicated their residency had been able to rededicate positions for other maintenance activities as a result of contracting**
  - **Fourteen indicated their residency had not reduced the number of positions as a result of increased contracting**
  - **Twenty-two indicated their residency had been unable to reduce overall maintenance costs as a result of increased contracting**

# **VDOT Should Improve Its Use of Equipment in the Field**

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- **VDOT should eliminate the underutilized equipment in the field by either selling or transferring it to other districts**
  - **VDOT's equipment division produces a quarterly report evaluating the utilization of all equipment by the department and identifying equipment that is underutilized**
  - **It appears the maintenance managers in the field do not adequately use the reports to assess the need for equipment for which they are responsible**
- **VDOT should also consider alternatives to the current rental strategy such as internal leasing, purchasing, or increased use of private contractors to provide certain rental equipment**

# **VDOT Should Develop and Implement a Best Practices Manual for Use by Field Personnel**

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- **Until 1994, VDOT maintenance personnel performed activities based on the 1991 Maintenance Guidelines Manual that provided very detailed information on how to complete a certain activity**
- **VDOT produced a new Maintenance Policy Manual in 1994 that streamlined much of the information in the previous manual and eliminated the detailed discussion of how activities should be performed**
- **The 1994 manual states that a “separate Maintenance Best Practices Manual is being developed, which identifies and updates specific maintenance procedures, levels of service, standards, and methods of operation.” However, a best practices manual has never been completed**

# **VDOT Should Develop and Implement a Best Practices Manual for Use by Field Personnel**

(continued)

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- **The need for a best practices manual was again addressed this summer**
  - **According to VDOT staff, a best practice policy was developed for snow removal shortly after the release of the 1994 manual but never implemented**
  - **A best practice policy for the preventive maintenance of pavements is currently being developed**
- **VDOT staff also said that development of the best practices for the primary maintenance functions would likely require several years**

# Recommendations

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- **Recommendations to improve the efficiency and effectiveness of the highway maintenance program include:**
  - **Developing and implementing adequate measures of highway maintenance productivity and properly managing the collection and use of data used to measure productivity**
  - **Addressing the internal policy which limits carry-forward of unexpended funding in the maintenance program**

# Recommendations

(continued)

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- **Expanding the use of equipment utilization reports to better monitor the use of equipment in the field, and transferring or disposing of underutilized equipment**
- **Implementing best practices for the activities with the greatest impact on the overall performance of highway maintenance and providing sufficient training to field operators**